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X. *The Conclusion of Dr. Defagulier's Account of Mr. Hales's Vegetable Staticks.*

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C H A P. VII. *Of Vegetation.*

OUR Author in this Chapter applies his several Experiments, and Conclusions drawn from them, to Vegetation; and shews chiefly the following Things, *viz.* That Vegetables are compos'd of Sulphur, volatile Salt, Water, Earth and Air.

That in Nutrition the Sum of the attracting Powers of those Substances is superior to the Sum of the repellent; and as the watry Vehicle flies off, the Parts harden.

That Oil, which is made up of Sulphur and Air, abounds in Seeds for their better preservation.

That in cold Countries, where those Principles are not so firmly united, small Wines, such as *Rhenish*, most easily yield their Tartar (which by Experiments appears to contain Oil and Air;) but generous Wines, such as *Madera*, having those Principles more firmly united, will bear a great degree of Heat before they part with them.

That the use of the Leaves of Trees is to bring up Nourishment within reach of the Attraction of the Fruit, to carry off the redundant watry Fluid; to imbibe Rains and Dews which are impregnated with Salt and Sulphur; as likewise to imbibe Air, and to be of the same use to Plants as the Lungs are to Animals.

That Plants which are overshaded, or too replet with Moisture, cannot so well imbibe Air: Therefore, tho' they will shoot out fast, and have much Wood, they will be more barren in proportion.

Mr.

Mr. *Hales*, by a very ingenious Contrivance, found the Degrees of growing in every part of young Shoots, which in their growing extend themselves most in the middle, and least towards the top and the bottom; the ductile Matter for their growth being drawn out in length like melted Glass-Tubes, which retain a Hollowness, tho' drawn out to the smallest Thread. N.B. *In some Animals there is such a tough ductile Substance, which hardens when expos'd to the Air in small Threads, as in Spiders and Silk-Worms.*

He shews, that the Pith serves to supply the dilating Moisture for the tender Shoots; but that their Figure may be oblong, and not round, as the Fruit commonly is, there are tough Diaphragms in the Pith at small distance from each other, which check the lateral Expansion; as also horizontal Fibres, which serve for the same purpose: And of the same sort is the Pith in the large growing Feathers of Birds; which is made up of Vesicles that can be distended lengthwise, but have Sphincters at the ends, to prevent too large a lateral Dilatation. — That the Bones of Animals do not grow at the Joynts (which would prevent their free Motions) but at the *Symphysis*, viz. where the Heads joyn to the Shanks of the Bones — That there are particular Vessels in Vegetables, as well as Animals, appropriated for conveying different sorts of Nutriment; and that where a viscid Substance is to be furnished, the Vessels are lengthen'd, and often fetch a compass to retard the Velocity of the Fluid, which is to be inspissated into an hard Substance. Thus in hard Stone-Fruits the Umbilical Vessel goes round the Concave of the Stone, and then enters the Kernel near its Cone.

Then at last, our Author traces the Vegetation of a Plant, from a Seed to a Tree again producing Seed; which

which Account, as it cannot well be contracted, without leaving out something material ; and as it serves to shew some of the excellent uses of our ingenious Philosopher's happy Discoveries, I shall (to conclude this Abstract) give in the Author's own Words.

“ Supported by the Evidence of many of the foregoing Experiments, I will now trace the Vegetation of a Tree, from its first seminal Plant in the Seed, to its full Maturity and Production of other Seeds, without entering into a particular Description of the Structure of the Parts of Vegetables ; which has already been done by Dr. *Grew* and *Malpighi*.

“ We see by *Experiment* 56, 57, 58, on distilled Wheat, Pease, and Mustard-Seed, what a wonderful Provision Nature has made, that the Seeds of Plants should be well stored with very active Principles ; which Principles are there compacted together by him, who curiously adapts all things to the purposes for which they were intended, with such a just degree of Cohesion, as retains them in that State, till the proper Season of Germination : For if they were of a more lax Constitution, they would too soon dissolve like the other tender Annual Parts of Plants : And if they were more firmly connected, as in the Heart of an Oak, they must necessarily have been many Years in germinating, tho' supplied with Moisture and Warmth.

“ When a Seed is sown in the Ground, in a few Days it imbibes so much Moisture, as to swell with very great force ; as we see in the Experiment on Pease in an Iron-Pot. This forcible Swelling of the Lobes of the Seed *ar, ar*, (Fig. 1.) does probably protrude Moisture and Nourishment from the capillary Vessels *r r*, which are called the Seed-Roots,

V u

into

“ into the Radicle  $c z d$ ; which Radicle, when it is thus  
 “ shot some length into the Ground, does then im-  
 “ bibe Nourishment from thence ; and after it has ac-  
 “ quir’d sufficient Strength, as this tender ductile Root  
 “ is extending from  $z$  to  $c$ , it must necessarily carry  
 “ the expanding Seed-Lobes upwards at the same time  
 “ that the dilating from  $z$  to  $d$  makes it shoot down-  
 “ wards ; and when the Root is thus far grown, it  
 “ supplies the Plume  $b$  with Nourishment ; which  
 “ thereby swelling and extending, opens the Lobes  
 “  $a r, a r$ , which are at the same time raised above-  
 “ ground with the Plume  $i$ , where they by expanding  
 “ and growing thinner, turn to green Leaves (except  
 “ the Seeds of the Pulse-kind ;) which Leaves are of  
 “ such importance to the yet tender Plume, that it  
 “ perishes, or will not thrive if they are pulled off :  
 “ Which makes it probable, that they do the same Of-  
 “ fice to the Plume that the Leaves adjoining to Ap-  
 “ ples, Quinces and other Fruit do to them, *viz.* they  
 “ draw Sap within the reach of their Attraction. (See  
 “ *Exper.* 8. and 30.) But when the Plume is so far  
 “ advanced in growth, as to have Branches and ex-  
 “ panded Leaves to draw up Nourishment, then these  
 “ supplemental seminal Leaves  $a r, a r$ , being of no  
 “ farther use, do perish ; not only because the now-  
 “ grown and more expanded Leaves of the young  
 “ Plant or Tree do so overshadow the supplemental  
 “ Leaves, that the former more plentiful Perspiration  
 “ is much abated ; and thereby also their power of  
 “ attracting Sap fails ; but also because the Sap is  
 “ drawn from them by the Leaves ; and they being  
 “ thus deprived of Nourishment, do perish.

“ As the Tree advances in stature, the first, second,  
 “ third and fourth Order of the lateral Branches shoot  
 “ out, each lower Order being longer than those imme-  
 “ diately

“ diately above them; not only on the account of  
 “ Primogeniture, but also because being inserted in  
 “ larger parts of the Trunk, and nearer the Root,  
 “ they have the advantage of being served with great-  
 “ er plenty of Sap, whence arises the beautiful para-  
 “ bolical Figure of the Trees.

“ But when Trees stand thick together in Woods or  
 “ Groves, this their natural Shape is alter’d; because  
 “ the lower lateral Branches being much shaded, they  
 “ can perspire little; and therefore drawing little Nou-  
 “ rishment, they perish: But the Top-Branches being  
 “ exposed to a free drying Air, they perspire plenti-  
 “ fully; and thereby drawing the Sap to the Top,  
 “ they advance much in height. But *vice versa*, if  
 “ when such a Grove of tall Trees is cut down, there  
 “ be left here and there a single Tree, that Tree will  
 “ then shoot out lateral Branches; the Leaves of which  
 “ Branches now perspiring freely, will attract plenty  
 “ of Sap; on which account, the Top being deprived  
 “ of its Nourishment, it usually dies.

“ And as Trees in a Grove or Wood grow only in  
 “ Length, because all the Nourishment is by the Leaves  
 “ drawn to the top, most of the small lateral shaded Bran-  
 “ ches in the mean time perishing for want of Perspira-  
 “ tion and Nutrition: So the case is the very same in  
 “ the Branches of a Tree, which usually making an An-  
 “ gle of about 45 Degr. with the Stem of the Tree, do  
 “ thereby beautifully fill up at equal and proper Distan-  
 “ ces the space between the lower Branches and the top  
 “ of the Tree, forming thereby as it were a parabolical  
 “ Grove or Thicket; which shading the Arms, the  
 “ small lateral Shoots of those Arms usually perish for  
 “ want of due perspiration; and therefore the Arms  
 “ continue naked like the Bodies of Trees in a Grove;  
 “ all the Nourishment being drawn up to the tops of

“ the several Branches by the Leaves which are there  
 “ expos'd to the warm Sun and free drying Air, where-  
 “ by the Branches of Trees expand much.

“ And where the lateral Branches are very vigo-  
 “ rous, so as to make strong shoots, and attract the  
 “ Nourishment plentifully, there the Tree usually a-  
 “ bates of its height : But where the Tree prevails in  
 “ height, as in Groves, there commonly its lateral  
 “ Branches are smallest. So that we may look upon a  
 “ Tree as a complicated Engine, which has as many  
 “ different Powers as it has Arms and Branches, each  
 “ drawing from their common Fountain of Life the  
 “ Root: And the whole of each yearly growth of the  
 “ Tree will be proportionable to their attracting Pow-  
 “ ers, and the Quantity of Nourishment the Root af-  
 “ fords. But this attracting Power and Nourishment  
 “ will be more or less, according to the different Ages  
 “ of the Tree, and the more or less kindly Seasons of  
 “ the Year.

“ And the proportional growth of their lateral and  
 “ Top-Branhes in relation to each other, will much  
 “ depend on the difference of their several attracting  
 “ powers. If the Perspiration and Attraction of the  
 “ lateral Branches is little or nothing, as in Woods and  
 “ Groves, then the Top-Branhes will mightily pre-  
 “ vail ; but when in a free open Air the Perspiration  
 “ and Attraction of the lateral Branches come nearer  
 “ to an Equality with that of the Top, then is the a-  
 “ spiring of the Top-Branhes greatly check'd. And  
 “ the case is the same in most other Vegetables, which  
 “ when they stand thick together, grow much in length  
 “ with very weak lateral Shoots.

“ And as the Leaves are thus serviceable in promo-  
 “ the growth of a Tree, we may observe, that Nature  
 “ has plac'd the Pedals of the Leave-stalks where most

“ Nou-

“ Nourishment is wanting to produce Leaves, Shoots  
 “ and Fruit ; and some such thin leafy Expansion is  
 “ so necessary for this purpose, that Nature provides  
 “ small thin Expansions, which may be called prima-  
 “ mary Leaves that serve to protect, and draw Nou-  
 “ rishment to the young Shoot and Leaf-buds before  
 “ the Leaf it self is expanded.

“ And herein we see the admirable Contrivance of  
 “ the Author of Nature, in adapting her different  
 “ Ways of conveying Nourishment to the different  
 “ Circumstances of her Productions. For in this *Em-*  
 “ *bryo*-state of the Buds a suitable provision is made  
 “ to bring Nourishment to them in a Quantity suffici-  
 “ ent for their then small Demands. But when they  
 “ are in some degree increased and formed, a much  
 “ greater quantity of Nourishment is necessary in pro-  
 “ portion to their greater Increase : Nature, that she  
 “ may then no longer supply with a scanty hand, im-  
 “ mediately changes her Method in order to convey  
 “ Nourishment with a more liberal hand to her Pro-  
 “ ductions ; which Supply daily increases by the greater  
 “ Expansion of the Leaves, and consequently the  
 “ more plentiful Attraction and Supply of Sap, as the  
 “ greater growth and demand of it increases. We find  
 “ a much more elaborate and beautiful *Apparatus* for  
 “ the like purpose, in the curious Expansions of Blof-  
 “ soms and Flowers, which seem to be appointed by  
 “ Nature, not only to protect, but also to draw and  
 “ convey a Nourishment to the *Embryo*-Fruit and  
 “ Seeds. But as soon as the *Calix* is form'd into a  
 “ small Fruit now impregnated with its minute semi-  
 “ nal Tree, furnish'd with its *Secundine*, *Chorion* and  
 “ *Amnion* (which new-set Fruit may in that state be  
 “ look'd upon as a compleat Egg of the Tree, yet in  
 “ *Embryo*) then the Blossom falls off, leaving this  
 new-



“ new-form’d Egg or first-set Fruit in this Infant-state,  
 “ to imbibe Nourishment sufficient for it self, and the  
 “ *Fœtus* with which it is impregnated : Which Nourishment is brought within the reach and power of  
 “ its Suction by the adjoining Leaves.

“ If I may be allow’d to indulge Conjecture (in a  
 “ Case, in which the most diligent Inquirers are as  
 “ yet, after all their laudable Researches, advanced  
 “ but little farther than meer Conjecture) I would  
 “ propose it to their consideration, whether from the  
 “ manifest Proof we have that Sulphur strongly attracts Air, a hint may not be taken to consider whether this may not be the primary use, of the *Farina fœcundans*, to attract and unite with it self elastick  
 “ or other refin’d active Particles.

“ That this *Farina* abounds with Sulphur, and that  
 “ a very refin’d sort, is probable from the subtil Oil  
 “ which Chymists obtain from the Chives of Saffron:  
 “ And if this be the use of it, was it possible  
 “ that it could be more aptly placed for the  
 “ purpose on very movable *Apices* fixed on the slender  
 “ Points of the *Stamina*, whereby it might easily with  
 “ the least breath of Wind be dispersed in the Air,  
 “ thereby surrounding the Plant as it were with an Atmosphere of sublimed sulphureous Pounce ? For many  
 “ Trees and Plants abound with it ; they may be perhaps inspir’d at several parts of the Plant, and especially at the *Pistillum*, and be thence conveyed to  
 “ the *Capsula seminalis*, especially towards Evening ;  
 “ and in the Night, when the beautiful *Petala* of the  
 “ Flowers are closed up, and they, with all the other  
 “ parts of the Vegetable, are in a strongly imbibing  
 “ state. And if to these united sulphureous and aerial  
 “ Particles we suppose some Particles of Light to be  
 “ joyned (for Sir *Isaac Newton* has found that Sulphur  
 “ attracts

“ attracts Light strongly) then the result of these  
 “ three by far the most active Principles in Nature,  
 “ will be a *Punctum Saliens* to invigorate the *Seminal*  
 “ Plant: And thus we are at last conducted by the  
 “ regular Analysis of vegetable Nature to the first  
 “ enlivening Principle of their minutest Origin.

P. S. *Since I began this Abstract, I was with the ingenious Author, who by some Experiments try'd since the writing of his Book, was become certain of some things which he spoke doubtfully of before, viz, 1. That the Diaphragm-Instrument (see Page 263, of his Book) wou'd serve to breathe  $8\frac{1}{2}$  Minutes when it was entirely dry, and the Diaphragms impregnated with Salt of Tartar. 2. That Leaves imbibe Air, as he has since tried in Mint in the manner that he mention'd (in Page 329.) 3. That this year the Heat of the Weather has been at 84 Degrees, mark'd on his Thermometers.*

F I N I S.

## Advertisement.

WHEREAS I publish'd a Paper concerning the Figure of the Earth, in the *Philosophical Transactions*, Numb. 388, and a Paragraph which I cancell'd, was, by the mistake of my *Amanuensis*, printed whilst I was sick: I desire such Readers as have that *Transaction* by them, to cancel from the Words, *Lastly, Let us suppose*, Page 280. Lin. *ult.* to the End of the Paragraph.

Having from time to time neglected to give this notice, I chose to do it here, tho' late, rather than wholly to omit it.

J. T. Desaguliers.